provide synchronized intermittent mandatory ventilation at such respiratory rates.

Assist Control Mechanical Ventilation

Assist control mechanical ventilation (ACMV) is a form of ventilation in which the ventilator provides a preset tidal volume in response to each spontaneous breath, regardless of the size of the tidal volume desired by the patient (Figure 6.3). Where the patient does not trigger the ventilator within the specified time interval, the ventilator will provide the preset tidal volume at the preset respiratory rate.

Synchronized Intermittent Mandatory Ventilation

Synchronized intermittent mandatory ventilation (SIMV) was originally developed as a weaning mode but was quickly adopted as the mainstream mode of ventilation because of its apparent advantages over the control mode. It is a mixed ventilatory mode that allows both mandatory and spontaneous breathing (Figure 6.4). The mandatory breaths can be pressure or volume regulated, and the spontaneous breaths can be pressure supported (or not). The SIMV algorithm is designed to deliver a mandatory breath in each SIMV breathe cycle, where the breath cycle is 60/(number of breaths per minute), in seconds. The mandatory breath is either patient or ventilator initiated.

The SIMV cycle has two periods: The first period is the mandatory period, which is reserved for the mandatory breath. If the patient does not trigger the ventilator during the mandatory period, the machine will deliver the preset mandatory breath at the end of this period. When the patient triggers the ventilator during this period, a preset mandatory breath is delivered and the mandatory period is terminated. The second period is the spontaneous period, which is reserved for the spontaneous breaths. The spontaneous period starts each time a mandatory period terminates. The main advantages of SIMV over CMV are maintenance of spontaneous respiratory activity, which results in continuous use of the respiratory muscle, and improved patient–ventilator synchronization. The result of the latter may be a reduction in the use of excessive sedation and neuromuscular blockade.

Mechanical ventilation can also be classified by whether the ventilator is set to deliver a predetermined tidal volume (volume-preset ventilation) or to achieve a predetermined plateau pressure (pressure-preset ventilation).

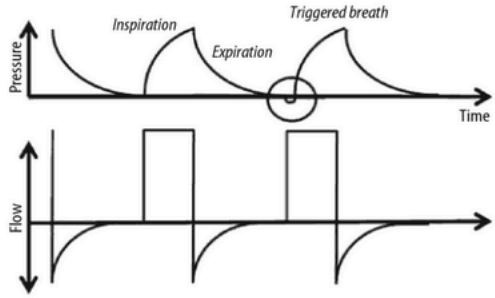

Figure 6.3. Assist control ventilation. When the patient does not trigger the ventilator within the specified time interval, the ventilator will provide the preset tidal volume at the preset respiratory rate (left). When the patient triggered the ventilator, a preset tidal volume in response to each spontaneous breath is delivered by the ventilator (right).

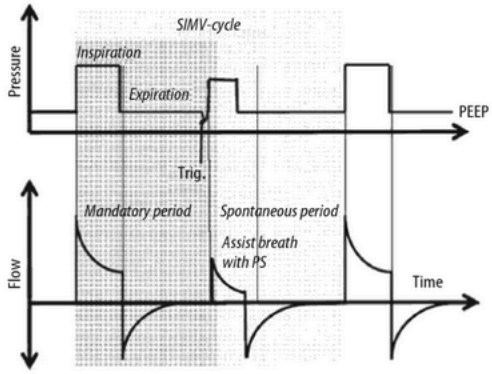

Figure 6.4. Synchronized intermittent mandatory ventilation (SIMV). The SIMV cycle consists of a mandatory period and spontaneous period. A breath effort during the SIMV mandatory period will deliver a breath with a preset volume or pressure. A breath effort during the spontaneous period will deliver spontaneous breath in the absence of pressure support, or pressure/volume supported breath. In case the patient does not take a breath during the mandatory period, the ventilator delivers a mandatory breath (volume limited or pressure limited).

Pressure-Preset Ventilation (Pressure-Limited Ventilation)

The breath is delivered at a set rate with a decelerating flow pattern and is terminated when a preset peak inspiratory pressure (PIP) is achieved (Figure 6.5). The tidal volume is determined by the preset PIP and respiratory system mechanics. The inspiratory time is usually set by the operator. Pressure-limited ventilation is usually recommended for patient with leakage around an uncuffed tracheal tube, in cases of obstructive lung disease (e.g., status asthmaticus), for neonates or small infants because measurement of the tidal volume is inherently inaccurate, or, rarely, in the presence of a bronchopleural fistula. When the tidal volume is measured at the ventilator, instead of at the end of the tracheal tube, then changes

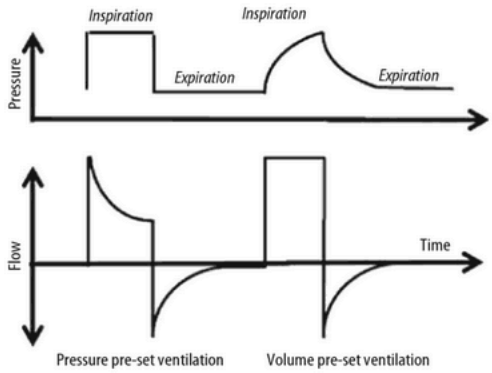

Figure 6.5. Pressure-limited breath (left) versus volume-limited breath (right). The same tidal volume is delivered in both modes. However, there is a decelerating flow in limited pressure mode (left) or a square wave flow in limited volume mode (right).

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